Openbaar gemaakt
den 29. JAN. 1920

121,961

PATENT SPECIFICATION

Convention Date (Italy), Oct. 13, 1917.
Application Date (in the United Kingdom), Dec. 24, 1918. No. 21,665/18.
Complete Accepted, Jan. 8, 1920.

COMPLETE SPECIFICATION.

Improvements in Driving Mechanism for Fluid Pressure Engines.

I, MARIO RIVA, of No. 8, Via Moncalvo, Turin, Italy, Constructional Engineer, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention has for its object to provide an improved crankless-engine of the type having pistons with variable length of stroke.

This improved engine whilst being more particularly adapted for use as an internal combustion engine, is nevertheless capable of being worked by any kind of motive fluid. The variability of the piston stroke which is effected by a fairly simple operation is intended mainly to produce considerable variations in the speed or power of the engine whilst retaining the co-efficient of efficiency of the engine proper unaltered.

In connection with engines of the type set forth it has been proposed to provide means whereby the centre of oscillation of a wobbler can be adjusted in an axial direction relatively to the cylinders, in order to vary the piston stroke and the compression space in the cylinder. In such constructions, however, the ratio between the piston stroke and the compression space does not remain constant but varies in accordance with the position of the oscillating centre of said wobbler.

According to the present invention means are provided whereby the ratio between the piston stroke and the free space or compression space in the cylinders is maintained constant irrespective of the position of the centre of oscillation relatively to the cylinders.

The improved engine comprises substantially an oscillating member that may have the form of a disc mounted so as to be capable of oscillating in all directions about a centre by means of a universal suspension joint of the cardan or spherical type. To this oscillating member at points spaced equally around its periphery there are pivotally connected the connecting rods of the pistons of the several cylinders that are arranged parallel to or converging towards one another. Said oscillating member is provided on its opposite side with a projecting part that is capable of sliding and also rotating in an eccentrically situated portion of a rotary member fixed to the driving (*i.e.* power-transmitting) shaft. For the purpose of varying the length of the stroke of the connecting rods and consequently of the pistons, means are provided for varying the distance between the point of articulation of the rotary member and the centre of oscillation of the oscillating member, the said means serving also for varying simultaneously the position of the said point of articulation of the

rotary member relatively to the engine cylinders as a whole, for the purpose of maintaining the desired ratio between the free space or explosion chamber in each cylinder and the cylinder volume correspondingly to the variable stroke of the piston.

A constructional form of the improved engine is illustrated by way of example in the accompanying diagrammatic drawings in which:—

Figs. 1 and 2 are similar vertical sections showing the improved engine in two different positions.

Fig. 3 is a vertical section on the line 3^x—3^x of Fig. 1.

Figs. 4 and 5 are horizontal sections respectively on the lines 4^x—4^x and 5^x—5^x of Fig. 1; and

Fig. 6 is a plan of the engine.

As shown the improved engine comprises a cylindrical frame 1 on and around the upper part of which are mounted the engine cylinders 2. These cylinders are three in number in the example shown and are arranged with their axes parallel to one another and to the axis of the frame 1.

Inside the frame is the oscillating member consisting of a disc 3 which is mounted so as to be capable of oscillating in all directions around a centre O by means of a universal suspension joint which in the example shown is of the cardan type but may equally well be of the spherical type. This suspension joint consists for instance of a ring 4 in the inside of which the disc 3 is mounted so as to be capable of oscillating on diametrically opposite pivot pins 5, whilst the ring 4 is mounted (by means of diametrically opposite pivot pins 6 which are arranged 90 degrees apart from the pivot pins 5) so as to be capable of oscillating on the ends of the arms 7^1 of an annular member 7 which for the purpose of varying the position as to height of the centre O is mounted so as to be capable of sliding axially in the frame 1 by means of one or more guiding feathers 8 fixed to the frame 1.

The lower ends of the connecting rods 9 of the pistons 10 of the cylinders 2 are pivotally connected to the oscillating member 3 at suitably spaced points thereof near its periphery. The articulation of these connecting rods to the oscillating member 3 is effected by means of a universal joint consisting for instance of a cross 11 which is pivotally mounted by two of its arms in the holes 3^1 of the member 3, whilst to its other two arms there is connected the lower forked end 9^1 of the connecting rod. The connection of the upper ends of the connecting rods to the pistons 10 is effected by means of a universal joint consisting for instance of the spherical end 9^{11} of the connecting rod working in a suitable cavity in the respective piston 10.

The oscillating member 3 is provided on its underside with a projection 12 consisting for instance of a cylindrical stem which projects at right angles from its centre and is slidably and rotatably connected to an eccentrically situated point 0^1 of a rotary member 13 fixed to (and also if desired constituting the flywheel of) the engine shaft 14. The axis of this shaft 14 which preferably coincides with the axis of the frame 1, passes through the centre O. The slidable and rotatable connection of the stem 12 to the point 0^1 of the member 13 is effected preferably by means of a universal joint consisting for instance of a sphere 15 through which the stem 12 is adapted to slide, whilst the said sphere is mounted so as to be capable of oscillating in a suitable seat surrounding the eccentrically situated point 0^1 of the member 13. The shaft 14 is supported by a collar 14^1 in such a manner as to be capable of rotating in but not of axially moving in, the central hub of the annular member 16 which for the purpose of varying if desired the position as to height of the rotary member 13 and consequently of the point 0^1 is mounted so as to be capable of sliding axially in the frame 1 by means of the same guide feathers 8 fixed to the frame 1 that serve to assure the axial sliding movement of the member 7.

As will be more clearly perceived from the following description of the manner of operation of the improved engine, for the purpose of producing the

variation in the length of stroke of the pistons it is necessary to vary the distance between the centre of oscillation 0 of the member 3 and the eccentrically situated point 0^1 of the rotary member 13, which point 0^1 is the centre of oscillation of the sphere 15. By reason of the slidable mounting of the members 7 and 16 in the frame 1, the required variation of the said distance may be effected for instance by providing the said members with one pair (as shown in the illustrated example) or with several pairs of oppositely inclined oblique slots 7^a and 16^a respectively. In the slots of each pair there engages a common pivot pin 17 which extends through a horizontal slot 1^a of the frame 1 and is fixed to a ring 18 that is mounted so as be capable of rotating in a mortice in the frame 1 and is adapted to be operated by means of a handle 19. The arrangement is such that on turning the handle 19 in the direction of the arrow in Fig. 4, each pivot pin 17 which is engaged in the two pairs of slots 7^a and 16^a, will depress the ring 7 and raise the rotary member 16, that is to say will cause the centres 0 and 0^1 to come nearer together and at the same time depress the centre 0 relatively to the cylinders 2 as a whole as shown in Fig. 2. It is clear that by suitably choosing the shapes of the slots 7^a and 16^a every given variation in the distance between the centres 0 and 0^1 will cause a correspondingly determined lower position of the centre 0 relatively to the cylinders 2 as a whole.

The operation of the improved engine is as follows:

It is to be understood above all that the alternating motion of the pistons 10 of the various cylinders produces a conical oscillation of the member 3 around the centre 0 so that the stem 12 is in its turn caused to have a conical motion around the centre 0 and consequently produces a rotational motion of the member 13 and driving shaft 14. Each piston 10 arrives at the end of its upstroke or downstroke when the articulation of its connecting rod 9 to the member 3 is situated at the highest and lowest point respectively corresponding to the maximum inclination of the member 3 in the one or other direction, as shown in full lines and indicated in dotted lines in Fig. 1. The stroke h of the piston is inversely proportional to the distance between the centres of oscillation 0, 0^1 of the members 3 and 15, whilst the height S of the free space above the piston in the cylinder, that is to say, the explosion chamber in the case of an internal combustion engine, depends on the position of the centre 0 relatively to the cylinders 2 as a whole.

When it is desired to produce a variation in the length of the stroke of the pistons, for instance from the length h (shown in Fig. 1) to the length h^1 (shown in Fig. 2), the ring 18 is rotated by means of the handle 19 in the direction of the arrow (Fig. 4). Then by reason of the above described arrangement the whole of the oscillating member 3 moves down, whilst the rotary member 13 rises. The distance $0—0^1$ is thereby diminished and consequently increases the length of the stroke from h to h^1. At the same time the lowering of the centre 0 relatively to the cylinders 2 as a whole will cause an increase from s to s^1 of the height of the free space above the piston in the cylinder, just as in the case of an internal combustion engine it is required that the capacity of the explosion chamber shall always be in a desired proportion to the volume of the cylinder charge.

The chief advantages of the improved engine, irrespectively of the nature of the motive fluid employed in the engine proper, consist essentially in this that the variation that can be effected according to this invention in the length of the piston stroke allows of obtaining wide variations in the speed as well as in the power of the engine without altering in any way the coefficient of efficiency of the engine. The absence of dead centres affords a perfectly uniform motion, whilst by reason of the small amount of oscillation of the connecting rods and the absence of a crankshaft, the connecting rods are not subjected to centrifugal action.

The example illustrated diagrammatically in the accompanying drawings is

designed more particularly as an internal combustion engine with three cylinders but it is to be understood that any desired number of cylinders may be provided and preferably an odd number on account of the better cyclic distribution of the explosions that can be obtained with an odd number of cylinders.

Instead of having their axes parallel to one another, the engine cylinders may also be arranged with their axes converging towards a point of the axis of the engine shaft. Likewise, instead of single cylinders, twin cylinders may be employed arranged preferably in the form of a V with a single twin connecting rod. The valves may be actuated by any suitable means, for instance by only two cams, one which actuates the admission valves, and the other actuates the exhaust valves.

Any suitable actuating mechanism may be employed for producing the variation in the relative positions of the oscillating member 3 and the rotary member 13. For the purpose of varying the position of the centre 0 relatively to the cylinders as a whole, the arrangement shown in the diagrammatic example of the improved engine may be reversed, that is to say, the centre 0 may be fixed, and the cylinders may be movable as a whole.

It is therefore to be understood that this invention is not limited in any way to the diagrammatic constructional form as illustrated, and without departing from the principle of the invention the constructional form may be modified in any way that may be considered to be necessary or advantageous in view of the requirements or circumstances of practical working.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. An improved crankless engine comprising pistons with variable length of stroke, of the type having an oscillating member mounted so as to be capable of oscillating in all directions around a centre by means of a universal joint of the cardan or spherical type to which are connected at uniformly spaced points near its periphery the connecting rods of the pistons of single or twin cylinders arranged parallel to or converging towards one another on one side of the said oscillating member which is provided on the opposite side with a projecting part capable of sliding and rotating in an eccentrically situated bearing of a rotary member fixed to the engine shaft, characterised by the provision of means whereby the ratio between the piston stroke and the free space or compression space in the cylinders is maintained constant irrespective of the position of the centre of oscillation of the oscillating member relatively to the cylinders.

2. An improved crankless engine constructed and operating substantially as hereinbefore described and also as illustrated in and by the accompanying drawings.

Dated this 21st day of December, 1918.

MARKS & CLERK.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1920.

FIG.1

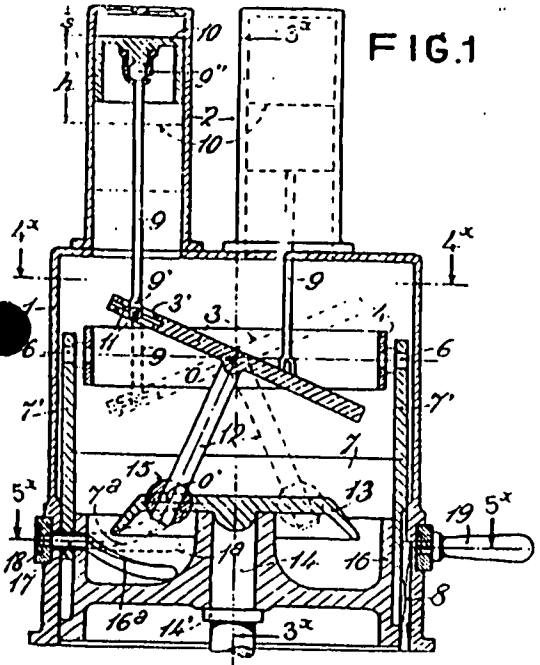


FIG.3

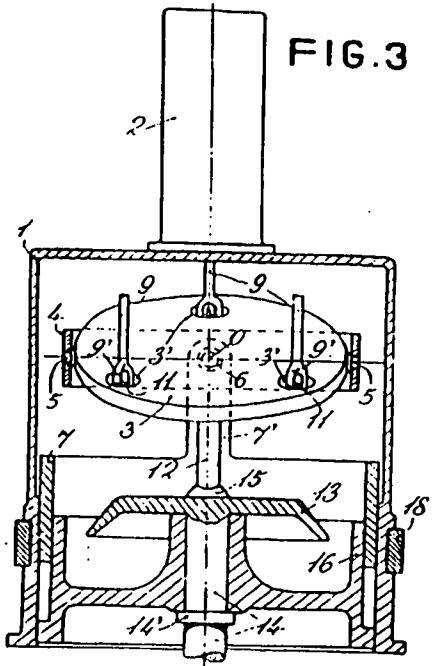


FIG.2

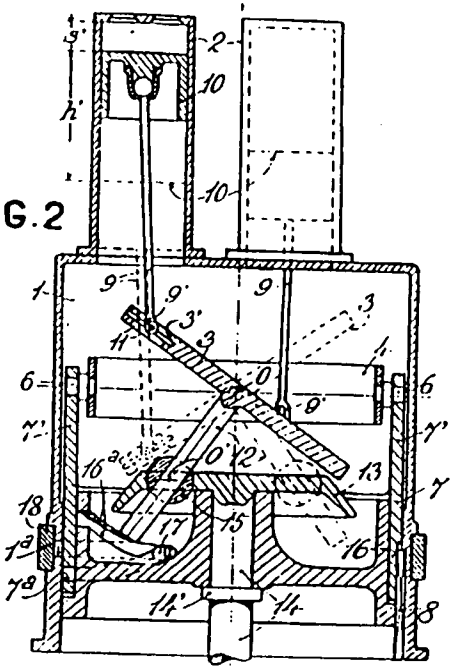
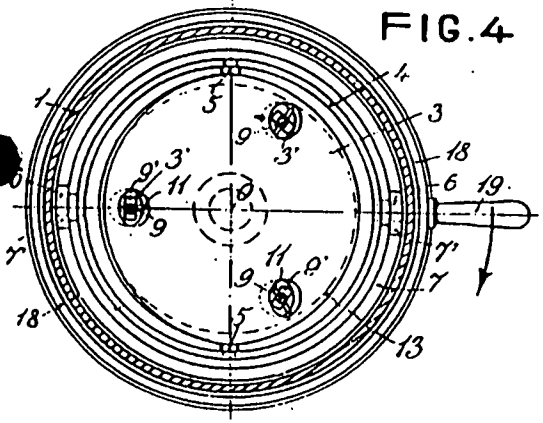


FIG.4



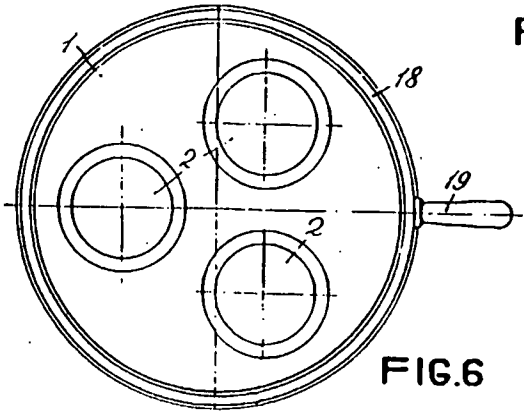
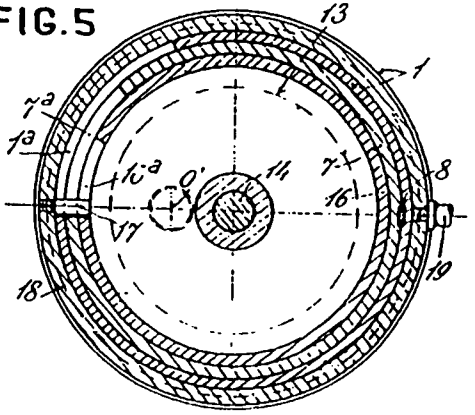


FIG.6

FIG.5



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